# Guns and Knives in New Mexico: Patterns of Penetrating Trauma, 1978–1993

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## ABSTRACT

**Objective:** To identify patterns of nonfatal and fatal penetrating trauma among children and adults in New Mexico using ED and medical examiner data.

**Methods:** The authors retrospectively sampled in 5-year intervals all victims of penetrating trauma who presented to either the state Level-1 trauma center or the state medical examiner from a 16-year period (1978–1993). Rates of nonfatal and fatal firearm and stabbing injury were compared for children and adults.

**Results:** Rates of nonfatal injury were similar (firearm, 34.3 per 100,000 person-years; stabbing, 35.1). However, rates of fatal injury were significantly different (firearm, 21.9; stabbing, 2.7; relative risk: 8.2; 95% confidence interval: 5.4, 12.5). From 1978 to 1993, nonfatal injury rates increased for children ($p = 0.0043$) and adults ($p < 0.0001$), while fatal penetrating injury remained constant. The increase in nonfatal injury in children resulted from increased firearm injury rates. In adults, both stabbing and firearm nonfatal injury rates increased.

**Conclusions:** Nonfatal injury data suggest that nonfatal violence has increased; fatal injury data suggest that violent death rates have remained constant. Injury patterns vary by age, mechanism of trauma, and data source. These results suggest that ED and medical examiner data differ and that both are needed to guide injury prevention programs.

**Key words:** injury; trauma; prevention, injury; firearms; knives; wounds, penetrating; morbidity; mortality.

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Penetrating injury is increasingly recognized as a public health threat. Firearms account for approximately 60% of violent deaths; knives and other sharp implements also contribute substantially to violent death.[1] This is particularly alarming for children, as increasing firearm fatality rates have been reported for this age group.[2] The epidemiology of penetrating injury comes largely from mortality data; a lack of morbidity data hinders a full understanding of the problem. Recently, ED data have been used to augment mortality data.[3]

In an effort to compare the patterns of nonfatal and fatal penetrating injury in children with that of adults, we compared a sample of children and adults who presented to an ED with penetrating injury with corresponding medical examiner data. We hypothesized that results from data sources would differ and that rates of penetrating injury, especially from firearms, would increase for children.

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## METHODS

**Study Design:** We retrospectively analyzed all victims of penetrating trauma (firearm or stabbing injury) who presented to either the state Level-1 trauma center or the state medical examiner over a 16-year period (1978–1993) to determine injury trends.

**Population and Setting:** We collected data from 2 sources: 1) the University Hospital ED in Albuquerque, NM (ED data), and 2) the Office of the Medical Investigator of the State of New Mexico (medical examiner data). University Hospital has been the only Level-1 trauma facility in the state since 1983. The hospital has historically served as the Bernalillo County medical center. The medical examiner investigates and certifies all injury deaths in the state and performs autopsies in circumstances in which the cause or manner of death is uncertain or a medicolegal issue is questioned.

From both sources, we selected all cases of penetrating trauma from firearms or stabbing/cutting implements for the first 6 months (January 1–June 30) of 1978, 1983, 1988, and 1993. For the medical examiner data, we selected all cases from Bernalillo County, which includes Albuquerque.

If a person presented to the ED more than once (12 persons) during the study period, we reviewed each presentation to determine whether subsequent visits were related to the initial injury. When related, we included only the first visit. One person presented twice for different injuries and we counted each visit separately.

**Measurements:** Data collected from the ED record included name, age, sex, date and time of visit, and method of injury. We defined children as patients <18 years old. Information about intent was not available from ED data. Data collected from the medical examiner records included name, age, sex, date of death, cause of death, agent of injury, and manner or intent of death.

Rates are expressed per 100,000 person-years. We used ED data to calculate nonfatal injury rates and medical examiner data to calculate fatal injury rates. We used the Bernalillo County population as the denominator for both data sets. Population denominators for rate calculations came from the 1980 U.S. Census for 1978 and 1983 and from the 1990 U.S. Census for 1988 and 1993.

**Data Analysis:** The direct method of adjustment corrected for changes in the distributions of age and sex over time, using the sum of the New Mexico 1980 and 1990 populations as the standard.[4] Relative rates were based on crude data.

We used the normal approximation to compare proportions, the $\chi^2$ test for differences in categorical data, and the unpaired t-test for differences of means.[5] The statistical package Epi-Info (version 5.01b; CDC, Atlanta, GA) provided trend analyses and confidence interval (CI) estimates for relative rates. A 2-tailed p-value $\leq 0.05$ was considered significant. Rates are reported with 95% CIs.

## RESULTS

We identified 641 ED and 221 medical examiner cases with penetrating injuries (Table 1). There were more children in the ED data compared with the medical examiner data (14% vs 10%, p = 0.12). Adults presenting to the ED with penetrating trauma were significantly younger than the medical examiner subjects (mean 30.1 vs 38.5 years, $t_{743} = 7.99$, $p < 0.0001$). Suicide was the most common

**TABLE 1** Demographic Characteristics, Method of Injury, and Manner of Death of Persons Presenting with Penetrating Trauma to the ED or the State Medical Examiner, by Age, Bernalillo County, NM, 1978–1993

| | ED | | | | Medical Examiner | | | |
|---|---|---|---|---|---|---|---|---|
| | Child | Adult | Unknown | Total | Child | Adult | Unknown | Total |
| Sex | | | | | | | | |
| Male | 91% (81) | 86% (472) | 83% (5) | 87% (558) | 77% (17) | 79% (157) | — (0) | 82% (174) |
| Female | 9% (8) | 13% (71) | — (0) | 12% (79) | 23% (5) | 21% (42) | — (0) | 18% (47) |
| Unknown | — (0) | — (0) | 17% (1) | 1% (4) | — (0) | — (0) | — (0) | — (0) |
| Age (years) | | | | | | | | |
| Mean | 14.2 | 30.1 | — | 29.9 | 15.6 | 38.5 | — | 36.1 |
| Median | 15 | 28 | | 26 | 16 | 35 | | 31 |
| Range | 4–17 | 18–81 | | 4–81 | 8–17 | 18–91 | | 8–91 |
| Method of injury | | | | | | | | |
| Stabbing | 30% (27) | 55% (299) | 67% (4) | 51% (330) | 5% (1) | 12% (23) | — (0) | 11% (24) |
| Firearm | 70% (62) | 46% (250) | 33% (2) | 49% (314) | 95% (21) | 88% (176) | — (0) | 89% (197) |
| Handgun | | | | | 62% (13) | 69% (122) | — (0) | 69% (135) |
| Rifle | | | | | 5% (1) | 12% (21) | — (0) | 11% (22) |
| Shotgun | | | | | 10% (2) | 7% (12) | — (0) | 7% (14) |
| Non-powder | 23% (14) | 2% (5) | — (0) | 6% (19) | — (0) | — (0) | — (0) | — (0) |
| Manner of death | | | | | | | | |
| Total fatalities | 3% (3) | 6% (33) | 33% (2) | 6% (39) | 100% (22) | 100% (199) | — (0) | 100% (221) |
| Homicide | — (0) | 48%* (16) | — (0) | 41%* (16) | 32% (7) | 40% (80) | — (0) | 39% (87) |
| Suicide | 67%* (2) | 45%* (15) | — (0) | 44%* (17) | 59% (13) | 57% (113) | — (0) | 57% (126) |
| Unintentional | 33%* (1) | 6%* (2) | — (0) | 8%* (3) | 9% (2) | 3% (5) | — (0) | 3% (7) |
| Undetermined | — (0) | 3%* (1) | 100%* (2) | 8%* (3) | — (0) | 1% (1) | — (0) | 0% (1) |
| TOTAL | 14% (89) | 85% (546) | 1% (6) | 100% (641) | 10% (22) | 90% (199) | 0% (0) | 100% (221) |

*Percentage estimates refer to the total 39 fatalities identified in the University Hospital ED data set (see text).

**TABLE 2** Age- and Sex-adjusted Nonfatal and Fatal Injury Rates for Persons Presenting with Penetrating Trauma to the ED or the State Medical Examiner, by Cause, Sex, and Age, Bernalillo County, NM, 1978–1993

| | Firearm | | | | Stabbing | | | |
|---|---|---|---|---|---|---|---|---|
| | Injury Rate* | *n* | Mortality Rate* | *n* | Injury Rate* | *n* | Mortality Rate* | *n* |
| Total† | 34.3 | 314 | 21.9 | 197 | 35.1 | 330 | 2.7 | 24 |
| Males‡ | 59.6 | 266 | 35.5 | 156 | 64.2 | 295 | 4.1 | 18 |
| <18 years | 43.6 | 55 | 12.7 | 16 | 20.6 | 26 | 0.8 | 1 |
| 18+ years | 67.0 | 210 | 44.6 | 140 | 84.5 | 265 | 5.4 | 17 |
| Females‡ | 9.8 | 46 | 8.9 | 41 | 6.9 | 33 | 1.3 | 6 |
| <18 years | 5.8 | 7 | 3.3 | 4 | 0.8 | 1 | 0.8 | 1 |
| 18+ years | 11.5 | 39 | 10.9 | 37 | 9.4 | 22 | 1.5 | 5 |

*Rate per 100,000 persons.
†Adjusted for age and sex.
‡Adjusted for age.

manner of death for both children (59%) and adults (57%).

Stabbing injuries comprised half of ED cases, but only 1 in 9 medical examiner fatalities ($p < 0.0001$). Among ED cases, more children presented with firearm than with stab injuries, while the reverse was true for adults ($p < 0.0001$). In contrast, there was little difference in the method of injury between children and adults in the medical examiner data ($p = 0.32$). When firearm type was specified in the medical examiner data, handguns accounted for the majority of fatalities for both children and adults. Sixteen percent (95% CI: 9.1, 25.1%) of children in the ED had nonpowder (BB/pellet) firearm injuries; only 1% (95% CI: 0.3, 2.1%) of adults had this type of injury. We identified no fatality from nonpowder firearms.

Nonfatal firearm injury rates were similar to nonfatal stabbing injury rates (Table 2). Among fatal injuries, New Mexicans were 8.2 times more likely to die from firearm than stabbing injuries (95% CI: 5.4, 12.5). Longitudinal trends showed significant increases in nonfatal firearm ($\chi^2$ trend test, 15.8, $p = 0.00007$) and stabbing ($\chi^2$ 19.1, $p = 0.00001$) injury rates among adults but an increase only in nonfatal firearm injury rates ($\chi^2$ 13.3, $p = 0.0003$) among children. Fatal injury rates remained constant for both children and adults (Fig. 1).

## DISCUSSION

Emergency department data show increasing nonfatal penetrating injury rates, but medical examiner data show constant fatal injury rates. In isolation, each data source could lead to distinct conclusions. Together, these data sets provide a better understanding of violent penetrating injury.

Until recently, children had consistently experienced low injury rates compared with adults. Consistent with other studies, we observed a disturbing increase in firearm injury rate among children.[2,3] The rapid growth of New Mexico's population and an increase in the incidence of gang-related violence may explain in part why children's injury patterns have increased and reached the same proportions as adults. The observed increase in nonfatal firearm rates in children without a concomitant rise in fatal firearm rates may be explained by several factors: assailants may be younger, may be less accurate, or may have used a lower-caliber weapon, such as a nonpowder firearm. Although the lethality of these weapons are lower than conventional firearms, the morbidity can be substantial.[6,7] Additionally, recent efforts to improve the quality of emergency medical services (EMS) for children may have reduced mortality with better care and treatment of childhood injuries.[8]

Firearms and knives contributed equally to nonfatal injuries, but most fatal injuries involved firearms. The greater availability of knives and the greater lethality of firearms may explain this difference.[9,10] Epidemiologic evidence demonstrates a strong relationship between the presence of firearms and the probability of violent injury.[11–13] Furthermore, firearms are the predominant method of injury among suicide deaths.[1] As suicide was the most common manner of death in the medical examiner data, it is not surprising that firearms were overrepresented in this data set. While firearm violence prevention strategies have concentrated on limiting access to firearms through restrictive licensing, waiting periods, and other methods, the pervasive ownership of sharp instruments at home limits the efficacy of this strategy for stab injuries. Instead, prevention of stab injuries must alter factors surrounding the injury event, such as the use of violence to resolve conflict, and alcohol and other drug use. These strategies could also reduce firearm injuries.

We were surprised to find increasing nonfatal injury rates when fatal injury rates remained constant. Using only mortality data, we would have been unaware of the increasing rates of nonfatal penetrating injury. The non-

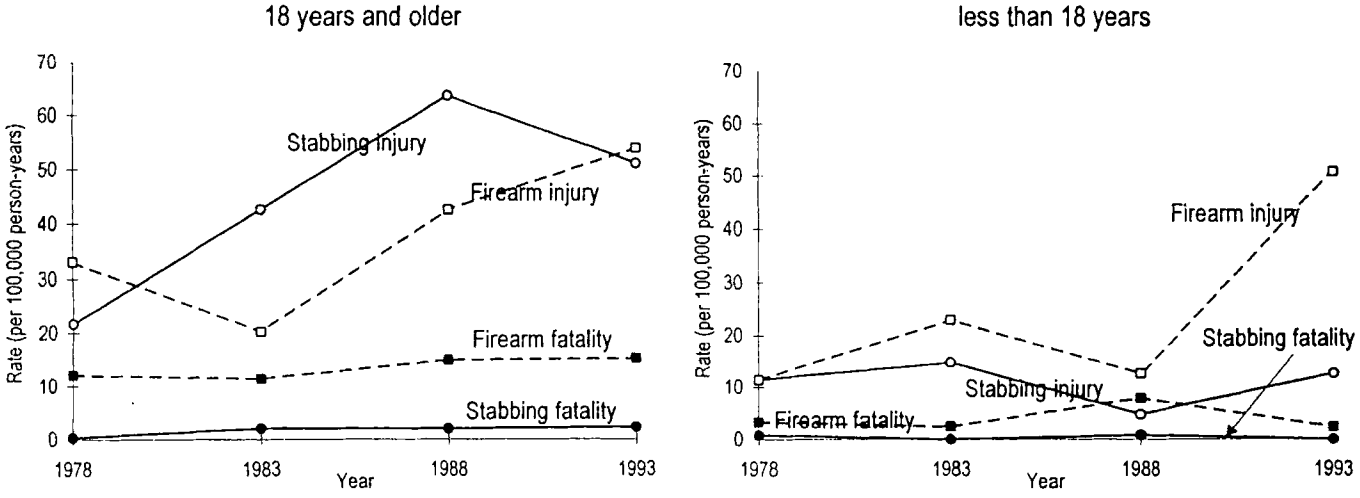


**FIGURE 1.** Nonfatal and fatal injury rates for persons presenting with penetrating trauma to the ED or the state medical examiner, by age, method, and year, adjusted for age and sex, Bernalillo County, NM, 1978–1993.

fatal trend is disturbing and highlights the importance of linking morbidity data with mortality data to provide a more detailed understanding of penetrating injury epidemiology. Morbidity data are usually more difficult to collect than mortality data and in the past have been used infrequently for public health purposes. Collection of morbidity data usually entails medical record review—a labor-intensive strategy that may deter public health professionals and other professionals from collecting these data. National and local efforts are under way to link morbidity and mortality data sources.[14,15] These efforts will provide a more comprehensive description of injury in the United States.

## LIMITATIONS AND FUTURE QUESTIONS

Our nonfatal penetrating trauma injury rate estimates almost certainly underestimate the true rates. Although the hospital has been the state's only Level-1 trauma facility since 1983, several other local hospitals treat penetrating injuries. This loss of cases to other facilities may be offset by cases referred to the Level-1 trauma facility from outside the county and, occasionally, from outside the state. Changes in county and statewide referral patterns may have occurred around 1983 with the trauma center designation, but recent increases cannot be explained by these changes. The New Mexico state trauma registry has collected data describing trauma admissions since 1990. Data for 1993 suggest that the Level-1 trauma center treats a slightly larger percentage of stabbing injuries (83%) than firearm injuries (66%), compared with the other hospitals in the county. Unfortunately, data prior to 1990 are not available (Rutledge L, New Mexico State Trauma Registrar, telephone conversation, Sept 16, 1996).

The selection of the months January–June for data sampling reflected practical sampling constraints and may introduce some bias, if patterns of penetrating injury are different in July–December with respect to children and adults. We have no information to support or negate this assumption.

Neither injury intent nor ethnicity was identified in the ED population. As a result, we could not compare the ED vs medical examiner data for these characteristics. Future studies need to focus on identifying injury intent in the ED population so that violence prevention programs can more correctly target unintentional from intentional violence and interpersonal from self-inflicted violence. A comprehensive population-based firearm injury reporting system that links nonfatal and fatal injury data sources, as suggested by Teret et al.[16] and being implemented by Hargarten et al.,[17] would obviate some of the limitations met by our study.

## CONCLUSIONS

Our analyses show that ED and medical examiner data portray different patterns of penetrating injury. Our ED data suggest a higher percentage of children, stabbing, and nonpowder firearm injuries, younger age, and increasing rates of firearm and stabbing injury. Medical examiner data demonstrate the contributions of firearm injuries and manner of death to patterns of fatal penetrating injury, and show constant rates over time. Reliance on either data source alone would have led to distinct conclusions. Both fatal and nonfatal injury data are needed to obtain an accurate picture of the epidemiology of penetrating injury in a community.

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